SEMI-ANNUAL REPORT

OF THE

WATER COMMISSIONERS,

FROM

JULY 1, TO DECEMBER 31, 1839,

INCLUSIVE.

DOCUMENT No. 42.

NEW YORK:

BRYANT AND BOGGS, PRINTERS.

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BOARD OF ALDERMEN,

JANUARY 6, 1840.

Semi-Annual Report of the Water Commissioners, from the 1st of July to the 31st of December, 1839, which was ordered on file and the usual number to be printed for the use of the members.

THOMAS BOLTON, CLERK.

To the Honorable the Common Council of the City of New York:

The Water Commissioners, in compliance with the Act of the Legislature, respectfully

REPORT:

That the Comptroller has been furnished with a statement of our receipts and disbursements, from the 1st of July to the 31st of December, 1839, inclusive.

The sum total expended, at each period of six months, from the commencement of operations to the present date, is as follows:

From July,	1835, to January, 1836,	$ 31,828 02
" January,	1836, to July, 1836,	12,070 84
" July,	1836, to January, 1837,	28,099 58
" January,	1837, to July, 1837,	62,602 85
" July,	1837, to January, 1838,	233,856 93
" January,	1838, to July, 1838,	605,766 76
" July,	1838, to January, 1839,	984,445 70
" January,	1839, to July, 1839,	715,362 01
" July,	1839, to January, 1840,	1,243,827 13
Total of expenditure		$3,917,859 82
Add balance in the hands of Commissioners		6,790 26
Total of requisitions paid by the Comptroller		$3,924,650 08

It is, perhaps, proper to state, that $6,671 79 of the above balance now in the hands of the Commissioners, was awarded by the Appraisers for the land required for the aqueduct, designated as belonging to George Bowne. He having appealed, however, from the decision of the Vice Chancellor, and the state of the case not permitting the money to be paid into Court, it is held by the Commissioners, until the question on the appeal is decided.

The following presents a pretty fair view of the several objects for which, the money drawn from the City Treasury during the last six months, has been expended. For details, we beg leave to refer to the account rendered the Comptroller, alluded to above:

1st. For land required for the work, and for temporary use, and for taxes and impositions	$ 5,005 84
2d. For work done and materials furnished by the contractors	1,186,461 97
3d. For salaries and incidental expenses of the Engineer Corps	22,465 08
4th. For iron pipes and other matters connected with that department	15,325 92
5th. For the salaries of the Commissioners and their Clerk, and for their incidental expenses	3,790 25
6th. For Chancery expenses and other law charges, including advertising, printing and stationery	10,778 07
Total of disbursements from July, 1839, to January, 1840	$1,243,827 13

In addition to the foregoing amount of disbursements for the last six months, there is in the hands of the Comptroller, the Commissioners' requisition number 151, for the sum due on *twenty-one* finished Sections, amounting to $168,048 04; and also, requisition number 153, for the estimated work performed, and materials furnished by the contractors, from the 25th of October to the 25th of December, 1839, including the balance due on *nine* finished Sections, amounting to $173,201 36, making a total of $341,249 40, which, added to the aforesaid semi-annual disbursements, will make the aggregate amount paid, and due, for the last six months, $1,585,076 53.

The progress of the work has rather exceeded than fallen short of our expectations. FIFTY-FOUR Sections of the *ninety-seven*, are finished, and there are several others nearly so. The augmentation therefore, is considerable, as the following comparative view of the additions made will show:

1st. The Aqueduct.—The whole length of aqueduct, arched complete, is 137,630 feet, running measure, or about 26 miles. That complete on the 1st of July last, as per our semi-annual report of that date, was 77,587 feet, or about 14 and two-thirds miles. The increase in this part of the work, since our last report, is 60,043 feet, or about *eleven and one-third miles.*

2d. Culverts.—There are now 114 culverts complete and in use for discharging the water of the several streams on which they are erected. Their length, in the aggregate, is 7,542 feet. The number completed at our last report was 92, and their length 6,240 feet. There is therefore an increase of *twenty-two culverts*, since the first of July last.

3d. Tunnels.—The number of tunnels excavated through their whole length, is *seven*, and they are, in the aggregate, 2,068 feet in length. There were five completed at our last report, of 1,195 feet in length, which shows an increase of *two* tunnels completed, of 873 feet in length. There are besides the above, *nine* tunnels in the progress of completion, that have been excavated in the aggregate, 2,133 feet, making the total of tunnelling up to the 25th of December, 4,201 feet, and of masonry on the aqueduct, within the tunnels, 2,476 feet, being an increase, during the last six months, of 1,964 feet in length.

4th. Foundation and Protection Wall.—The foundation wall now laid, amounts to 115,210 cubic yards, and the protection wall to 114,384, making a total of 229,594 cubic yards of dry wall, which shows an increase, during the last six months, of 63,344 cubic yards of wall.

5th. Ventilators and Waste Weirs.—There are 24 of these necessary structures now finished complete. A large portion of them are intended as ventilators to discharge the superabundant air collected in the aqueduct, and a few of them, are fitted for waste weirs, for discharging the water from the aqueduct, if at any time repairs should be required, or any other cause make it necessary. There were *six* com-

plete on the first of July last, making an increase of *eighteen* in this description of the work. Besides the foregoing, there has been a great deal of work performed, which cannot be described with the necessary degree of accuracy and plainness to make it understood, such as earth and rock excavation, which has been performed before the grade of the aqueduct could be reached; embankment and backfilling, performed after the aqueduct is in form, &c.

There is still about *six and a half miles* of aqueduct yet to complete, in the County of Westchester, and about *seven and a half miles* of aqueduct and pipe work, on the Island of New York, making the length of the unfinished work, about *fourteen miles*. For more particular data, see the report of the Chief Engineer on the progress of the work, dated the 24th of December, 1839, which is herewith submitted.

The total expenditure of the past year, from January, 1839, to January, 1840, including sums due on the 1st instant, amounts to $2,300,438 54. This is a much larger amount than has been disbursed at any one period since the commencement of the work, and may be accounted for, by the great number of Sections completed, when the 10 per cent., reserved as a retainer, until the contracts are finished, must be paid. The difficulties which have been encountered by the Corporation, in raising the necessary means, during one of the most trying times of our monetary affairs, have been met in a spirit, which, as we think, ought to give perfect satisfaction to the contractors. These unpleasant times are now passing away, and a gradual improvement may be anticipated for the year 1840, when the sum necessary to carry the work through, will be obtained with much less difficulty than what has heretofore been experienced. This is only offered as a volunteer opinion, and may perhaps, be considered out of place, as the Commissioners have no agency in raising the means for carrying on the works; they have, however, a strong desire that the evils that must result from

a suspension, may be avoided, believing, as they do, that the loss of interest on the capital already disbursed, the claims of the contractors for damages, and the injury to the partly finished Sections, would be far greater than any additional interest that may be demanded on the sum required to carry the operations on to perfection.

In order that some opinion may be formed of the probable amount required for the present year, the Commissioners, with the assistance of the Chief Engineer, have endeavored to make an estimate of the sum that may be necessary to carry forward the work until January, 1841; and we state the amount, including unpaid requisitions and contingencies, at $2,100,000; a sum, in our view, fully sufficient to pay every demand that can be made upon the Commissioners during the aforesaid period.

In our last report we stated, that a notice had been issued, inviting proposals for building a lofty bridge of masonry, including materials, for crossing the Harlaem River with the Croton water; the work to be completed on or before the first day of August, 1843. The proposals were to be received on the 29th of July, 1839, twenty-nine days after the said report was presented to your Honorable Body, which precluded the Commissioners from reporting on the subject until now. The result of the proposals were as follows:

There were *thirteen* bidders for the work and materials, the lowest of which was made by John B. Ives, Robert Nixon, George T. Olmstead, and Charles A. Olmstead, amounting, by estimation, to $737,755. Ives & Company, however, declined taking the work for the sum proposed, and the Commissioners offered the contract to Timothy N. Ferrell, George Law, Samuel Roberts, and Arnold Mason, who were then contractors on the aqueduct, and well known to the Commissioners. The amount of their bid, as estimated, was $755,130. They acceded to the proposal, and having furnished the requisite security, the contract was executed on the 13th of August, 1839.

We also gave a synopsis of the Act of the Legislature, passed on the 5th of May, 1837, authorizing an alteration in the route of the Croton turnpike and public roads, parts of which would be destroyed by damming the Croton River; and we stated, that Commissioners had been appointed by the Governor, for the purpose of designating the route of the said roads; that the Commissioners had performed the duties assigned them, and that application had been made to the Vice Chancellor of the Second Circuit, in conformity with the provisions of said Act, for the appointment of Appraisers, to estimate the value of the land required for the new roads, as substitutes for those to be destroyed by the aforesaid means.

At the request of the Commissioners, the Vice Chancellor appointed William Jay, William Nelson, and Jeremiah Anderson, Esquires, the two first of whom are gentlemen that have acted as Appraisers on all the land heretofore taken for the aqueduct and Croton Reservoir in the County of Westchester. They met on the 24th of July, and completed their appraisement on the 25th of the same month. The quantity of land taken for the new roads was 12 acres 682 thousandths, and the amount awarded, in the aggregate, was $3,629.

The report of the Appraisers was confirmed by the Chancellor on the 13th of August, and the respective awards paid the owners of the land as they were called for.

The following schedule embraces all the land taken by appraisement for the new roads, as substitutes for those that will be covered by the Croton Reservoir:

Names of Owners.	Quantity of land.		Amount paid.	When paid.	Deed, when deposited with the Comptroller.
	Acres.	Thousandths.	Dollars.		
David Birdsall		556	75	24th Sept. 1839	The deeds are at the office of the Clerk of Westchester, for record.
Jonathan Purdy	2	521	609	12th Oct. "	
Robert Flewwelling	3	021	500	1st Oct. "	
John Flewwelling		313	50	18th Sept. "	
Daniel Sutton		850	1,100	2nd Oct. "	
Catharine Craft		107	40	18th Sept. "	
Isaiah Flewwelling	1	316	230	18th Sept. "	
Garret Vandeveer		590	250	9th Oct. "	
Henry Griffin	1	948	550	2nd Oct. "	
John R. Griffin		830	130	2nd Oct. "	
Elias Reynolds		238	45	24th Sept. "	
Robert Sutton		392	50	18th Sept. "	
	12	682	$3.629		

On the 2nd of September, 1839, notice was given that the Water Commissioners would receive proposals until the 30th, at seven o'clock, P. M. at their office in the City of New York, for the construction of certain roads near the Croton Reservoir, including a bridge over the Croton River, and for grubbing and clearing the trees and bushes from the ground forming the area of the Croton Reservoir; and also for excavating the earth from such shoal places as would, when the reservoir was full, be covered with a small depth of water; the price for the work, to include the necessary materials, according to a plan and specification in the office at Sing Sing; the whole work to be completed on the first day of October, 1840.

There were fifteen bids for constructing the roads, and other work connected with the job; the lowest of which was made by George Clark and Dexter Legate, amounting, by estimation, to $32,122; and they having furnished the requisite security, a contract, between them and the Commissioners, was executed on the first of October last.

Notwithstanding it was pretty generally understood that the situation of our monetary affairs would, and no doubt did, in a measure, induce the contractors to reduce the number of their workmen, and thus retard, more or less, their operations, it is now quite evident, from the large amount dis-

bursed during the last six months, that the work has progressed nearly equal to what we had a right to expect under ordinary circumstances. Most of the contractors have completed their contracts by, and in several instances before, the time limited; and there is now hardly a doubt that the whole line, from the Croton to the Harlaem River, will be finished some years before the expensive and difficult work over the said river can be.

It must not be inferred, however, that because more than half the sections are completed, and an additional number of them nearly so, that the work still to be performed is of but small amount; on the contrary, we consider what is yet to be done, as some of the most difficult and expensive operations still to be performed. The very important and stupendous works at the Harlaem River are scarcely commenced, and at the expensive crossing at Manhattanville, the Clendining Valley, and in the erection of the receiving and distributing reservoirs, there has been much less than a fourth of the work completed. In fact, as it now appears, the operations on the Island of New York, including the crossing of the Harlaem River, which embraces a distance of only about seven miles in length, will cost rising three millions of dollars, or about one and a half million less than the estimates of D. B. Douglass and John Martineau, Esquires, for the whole work.

The first examination and estimate by Major Douglass, was made in 1833, and amounted to $4,718,197. In 1835 he re-examined the subject thoroughly, and then estimated the whole cost of the work, including the crossing of the Harlaem River with a high arched bridge, and including the land damage, and water rights, and ten per cent. for contingencies, at $4,786,637; and Mr. Martineau, in the same year, made a survey of the whole line, from the Croton to this city, and estimated the cost of introducing the water, including the crossing of the Harlaem River by inverted syphons, and a low bridge, with the cost of the land to be occupied

by the aqueduct, and twelve and a half per cent. for contingencies, at $4,225,814.

This apparent agreement between the Engineers, differing not materially with each other, naturally induced the Commissioners to conclude that their estimates were nearly correct, and that the total cost could not exceed five millions of dollars; especially as these gentlemen had frequently been requested to be sure to make their estimates full and ample to cover the whole expense, of whatever nature, in order that the Common Council, and our citizens generally, might not be deceived as to the actual disbursements for completing the whole project. As it now appears, however, these estimates were entirely delusive, and will fall far short of the actual cost. The Commissioners, in stating these facts, by no means intend to censure the Engineers, for they are perfectly aware of the difficulty in attempting an exact estimate of so expensive and costly a work, two years before any part of it could be placed under contract. The difference in the cost of land, from the ideal value placed on it by speculators and interested persons, was beyond calculation; and the price of work and materials had varied materially, between the years 1835 and 1837. The whole project, in fact, was entirely new, and perhaps without precedent as to cost, and therefore it ought not to be considered as a want of talent, if mistakes were made in estimating its expense.

On the 11th of October, 1836, John B. Jervis, Esq., was appointed Chief Engineer of the New York Water Works, and he entered on the duties of his office on the 1st of November thereafter. He succeeded in preparing 23 Sections of the first division of the work, for contract, on the 28th of February, 1837. The work being of an unusual character, differing materially from that required for rail roads, bridges, or canals, the notice inviting proposals, were extensively circulated. The whole of the 23 Sections were offered to be taken, but the bids for 10 of them, were deemed greater than

the work and materials were worth, and therefore only 13 of the offered Sections were placed under contract.

On the 27th of December, 1837, Mr. Jervis made an estimate of the cost, so far as the engineering was concerned, of the whole line of the work. This estimate was based on the experience then obtained, and the prices at which the contracts had been taken, and after adding eight per cent. for contingencies, but excluding the cost of land, water rights, and the incidental expenses of the Commissioners, the total of his estimate amounted to $7,877,466

At the same time the Commissioners attempted an estimate of the cost of the land required for permanent and temporary uses, and for salaries, Chancery and law expenses, with the probable cost of printing, stationery, &c., amounting in the aggregate to 586,567

Making the total cost of the Commissioners' plan $8,464,033

The additional cost of crossing the Harlaem River by a high arched bridge, including the difference of $443,432, will bring this estimate up to about *nine millions;* and the loss of interest, with other contingencies arising from the extended time required for crossing said river, in the mode now proposed, will swell this amount, as the Commissioners fear, to more than double the estimates made by the first Engineers employed, for the cost of the whole work.

As the work has now arrived at a state of great forwardness, and most of the perplexing causes of delay removed, it will, on the opening of the next season, go forward with considerable rapidity, should no unforeseen circumstance intervene to prevent. The Sections contracted to be finished in 1839, except in one or two instances, are completed, and also several of those under contract to be finished in 1840 and 1841. The remaining sections, except that embracing the crossing at Harlaem River, are under contract to be com-

pleted in 1841; and the Commissioners have had under consideration, a suggestion of the Chief Engineer, in his report to them of the 1st of June, 1839, (see Doc. No. 10, p. 156,) and have concluded, should the Sections under contract to be completed in 1841, be finished at that period, to erect a temporary conduit pipe of proper dimensions, and resting on the coffer dams in the river, for conveying the water from the aqueduct on the Westchester, to the New York side; and from thence, through the aqueduct to the reservoirs; by which means the city may have the benefit of the water one or two years prior to the time we should be enabled to conduct it by the more perfect and permanent means of the bridge to be erected for that purpose. The additional expense of the project cannot be great, as the pipe used, when the work is completed, may be removed and applied to the purpose of city mains. There will have been expended, up to 1841, inclusive, a capital, amounting, probably, to seven or eight millions of dollars, the interest on which, at the rate of five per cent. for two years, will be seven or eight hundred thousand dollars. It is therefore important, that every proper facility should be afforded the contractors, in order that their contracts may be completed by the time stipulated—the water introduced, and an income derived from its use in liquidation of the interest on the capital expended.

We have so often alluded to the difficulties and causes of delay, with which we have had to contend, in the prosecution of the work, that now, when they have in a great measure ceased, we beg leave merely to refer to some of them, as matters of gone by events. Those relating to the obtaining possession of the requisite land, have all been adjusted, and the awards paid, except in two cases, namely: that taken by appraisement from the farm of Rebecca Dyckman and others, and that taken in the same manner from the land of George Bowne—the former having appealed from the decision of the Vice Chancellor, and the latter having also appealed, and commenced a suit against the contractors for

trespass. The contracts for the whole work, except the grading of the Fifth avenue for the iron pipes, have been signed, sealed, and delivered, and what has been deemed ample security for their performance, obtained. The complaints of the inhabitants, residing in the vicinity of the work, have in a great measure ceased, they having found the annoyance from the operatives much less than what was anticipated. The opponents to the mode recommended by the Commissioners for crossing the Harlaem River, have been gratified by an Act of the Legislature, compelling the Commissioners to build a bridge with high arches of one hundred feet in the clear; and all that is now left, of a perplexing character, is the occasional claims of the contractors for what they deem extra work, or expenditure for the temporary use of land, in completing their contracts; and in a few cases, the claims of the owners of the adjoining land, for injury arising from the earth and stone left on it by the contractors. The duties now to be performed by the Commissioners, therefore, are, principally, a rigid and strict inspection of the work as it progresses, in order that it may be faithfully and permanently performed as heretofore, and the economical disbursement of the funds placed in their hands, as agents of the Corporation.

In order to the establishment of a competent Corps of Engineers, the Commissioners have found it impracticable to make satisfactory selections with the advantages of experience, except the gentlemen composing the corps were permanently engaged. But the rodmen and others attached to the corps, have been without inconvenience, annually discharged during the winter months. There are, therefore, fifteen Engineers, including the Chief, now under permanent engagement, on the works; and believing their ordinary avocations would admit, now that the works are in such a state of forwardness, we have directed their leisure time to be occupied through the winter, in collecting materials and forwarding the construction of a corrected map and profile of the whole route of the aqueduct, with the topography of the

adjacent country; an object of some importance to the future, and one that could not be so well executed by other hands than those who have been familiar with the works and country through which the aqueduct passes.

The following sums have been paid by the Commissioners since their last report, for land to be used as embankments, for the deposit of materials, &c.:

To S. A. Halsey, for use of land during the construction of the aqueduct	$ 50 00
To John Stephens, for building a truck waggon	250 00
To John R. Griffin, for land to be used for embankment	250 00
To Frederick Brown, for damages to his premises in excavating a tunnel	250 00
To Edward Kemeys, for land purchased	42 65
To Lemuel Wells, for one year's rent of land	225 00
To Robinson and Weatherbee, for damage to their land	15 00
To Joseph Auser, for use of land for deposit of materials	25 00
To tax for work on roads, Town of Greensburgh	16 50
To tax on property, Town of Mount Pleasant	67 88
To tax on property, Town of Greensburgh	394 20
To S. & L. Mott and others, for use of land	125 00
	$1,711 23

The Commissioners have presumed, as their present report is but moderate in extent, it might be interesting to your Honorable Body, if they attempted a brief description of the whole line of aqueduct, noting as we proceed, the most difficult and expensive parts of the work, such as the hills that have been penetrated by the tunnellers, and the deep chasms, valleys, streams, and rivers, over which the aqueduct has

passed, or has to pass, in extending the line from the Croton River to this city.

The line of aqueduct, from the dam on the Croton, to the distributing reservoir on Forty-second street, is about 40 miles in length. For convenience, it has been divided into four parts, or divisions. The first division commences at the dam, and extends some distance below the Village of Sing Sing, or about 10 miles from the place of commencement. The second division commences where the first ends, and extends several miles below Tarrytown: it is about 11 miles in length, and ends 21 miles from the dam. The third division commences at the end of the second, and extends some miles beyond the Village of Yonkers: its length is about 10 miles, and it ends 31 miles from the dam. The fourth division includes the whole distance from the termination of the third, to and embracing the receiving reservoir, and is 7 miles in length. Its termination is about 38 miles from the dam; and from thence to the distributing reservoir at Murray hill, or Forty-second street, is about 2 miles; making the whole length, as first stated, 40 miles.

To each of these divisions, there has been appointed a Resident Engineer, with a competent number of Assistants, who have the immediate care and oversight of the operations within their respective divisions; and for the purpose of making as equal a distribution of the work as practicable, the divisions have been further divided into Sections of various lengths, according to the magnitude of the work to be performed in each: they amount in the whole to 97, including the contract for building the distributing reservoir.

An important part of the work is the aqueduct, which is to convey the water from the Croton reservoir to the receiving reservoir, a line of 38 miles in length. Its dimensions are about 6 feet at bottom, 7 feet at top, and from 8 to 10 feet in height. It is higher for about 5 miles of its progress from the Croton, than it is on the remainder part of its route.—The reason for this is, that the head of water entering the

aqueduct, may never be diminished by severe droughts, but always competent to a full supply. The floor of the aqueduct for this purpose, is sunk 2 feet deeper at the dam, leaving the floor at the mouth about 10 feet below the water level of the reservoir; from which the aqueduct regularly diminishes in height, until it reaches the proper dimensions.

The foundation of the aqueduct is stone, well laid, and the interstices filled up with rubble, and over this, a bed of concrete, composed of cement, broken stone and gravel, in due proportions, well mixed and combined together, except where the original earth is of a compact and dry consistence, when the stone foundation is omitted, and the bed of concrete laid on the earth foundation. The side walls are of good building stone, 39 inches thick at bottom, and 27 at top, having a batter of 3 inches to 12. These walls are laid in regular courses, and built with great care and under strict inspection, in order that the water may be prevented from escaping or entering the aqueduct. The bottom, or flooring of the aqueduct, is an inverted arch, and the top or roof, is a semi-circle. Both arches are turned with brick of the most durable quality, and the interior surface of the side walls has a coat of hydraulic mortar, and is also lined with the same material of brick, so that the whole presents to the action of the water, no obstacle to its passage. The whole of the mason work is constructed with mortar composed of the best hydraulic lime and sand, and there can scarcely be a doubt therefore, that the work will stand the test of time, and answer all the purposes for which it was designed.

Having thus described the construction of the aqueduct, we will proceed with a description of the Croton dam. This dam will back up the river several miles, and cover with water, exclusive of the bed of the river, between five and six hundred acres of land, thus forming the great reservoir from whence the aqueduct draws its supply. It is located about 40 miles north of the City of New York, on the Croton River, 5 miles above its mouth, and where recently stood the

mill belonging to Wilhelmus Garretson. The top, or lip of the dam, is about 100 feet wide across the river; 70 feet at bottom, and 7 at top, averaging about 40 feet in thickness. The whole structure will be a mass of substantial stone masonry, combined together with hydraulic cement, and when complete, one of the most stupendous erections of the kind to be found in this or any other country.

Immediately after the aqueduct leaves the dam, it passes through a tunnel in rock, of 180 feet in length, designated as the *Corporation Tunnel;* and at about 1 mile further south, it crosses Lounsberry's Brook, where there is a culvert of 6 feet in diameter and 66 feet in length. In crossing this valley, the grade line is 40 feet above the brook, and 55 to the top of the aqueduct.

The next valley of importance, is at Indian Brook, about 5 miles from Lounsberry's, and 6 from the dam. In crossing this valley, the foundation wall is raised 45 feet, in order to bring the valley up to the grade line of the aqueduct. The culvert for passing the water of the stream, is 8 feet in diameter and 142 feet in length. Immediately on leaving the valley, it became necessary to carry the aqueduct through two elevated pieces of land in the immediate vicinity of each other: the first, the "*Benveneu Farm Tunnel*," 720 feet in length through solid rock; the second, the "*Acker's Brook Tunnel*," 166 feet in length, also through rock—both tunnels are on the 15th Section of the aqueduct.

On Section 16, half a mile south of Indian Brook, and six and a half from the dam, another tunnel, designated as "*Hoag's Hill Tunnel*," is driven through the solid rock, 276 feet in length. From this to Sing Sing, there are a number of small valleys and hollows to be passed by the aqueduct, varying in depression from 5 to 18 feet, and averaging about 12 feet each below grade line, and 25 feet below the top covering of the aqueduct.

At the entrance of the Village of Sing Sing, the first object is the "*Sing Sing Kill Tunnel*," carried through solid

rock for 334 feet in length. At the south termination of this tunnel, the foundation wall of the aqueduct crosses, in its progress, one of the main roads of the village, and an archway of 20 feet span, with 5 feet rise, had to be thrown over it, leaving the carriage way unobstructed. After crossing said road, the aqueduct enters the land of the late John Sing, where a viaduct or passage way, is constructed beneath the aqueduct, of 7 feet span, and height in proportion, erected for the purpose of opening a way from the dwelling to the garden of the proprietor.

We thus arrive at the crossing of Sing Sing Kill, 2 miles from Indian Brook, or about 8 from the dam. This run of water, although an inconsiderable stream, requires a very expensive operation in crossing it. The chasm worn by the water, is about 70 feet in depth, and is crossed by an aqueduct bridge of 88 feet span, with an eliptical arch of 25 feet rise, resting on abutments of stone masonry, with pilasters projecting 2 feet beyond the face. The abutments are composed of regular courses of well hammered stone, carried back to the solid rock, and dressed to a joint of a quarter of an inch; each course is of the same sized stone. In order that all possibility of leakage may be prevented, that part of the aqueduct which crosses the bridge, is to have a lining of cast iron, composed of plates five-eighths of an inch thick, and put together with screw-bolts and nuts, and well caulked.—On this bridge the aqueduct passes from the north to the south side of the creek, and proceeds in its course over ground quite favorable for about 1 mile, when it enters the State Prison Farm.

On entering the property of the State, and at about 9 miles from the dam, we meet with two tunnels in the vicinity of each other. First, the "*State Prison Farm Tunnel, number one*," is 416 feet in length, partly through earth and part through rock; and second, the "*State Prison Farm Tunnel, number two*," 375 feet in length, entirely through earth. From this to Hale's Brook, about 9½ miles from the dam,

another tunnel is encountered of 260 feet in length, designated as "*Hale's Brook Tunnel.*" In passing the valley of Hale's Brook, the grade line is 35 feet above the stream, and the top filling of the aqueduct, 49 feet. The culvert for passing the water of the brook, is 6 feet in diameter, and 131 feet in length. About 1 mile below this, we cross the valley of Rider's Brook, where the foundation wall is 20 feet high from the bed of the stream, to grade, and 34 to the top line of the aqueduct; the culvert is 6 feet by 100. This brings us to the end of the first division.

The first object of note, which arrests the attention on the second division, is the road-culvert, or viaduct, erected over the highway, for the purpose of crossing it with the aqueduct. The arch of this erection is 20 feet span, and both the arch and abutments are built of stone, well hammer dressed. The whole fabric is finished in a neat and substantial manner. Proceeding south, we arrive at another piece of high land, through which a tunnel has been worked of 186 feet in length. This tunnel lays about eleven and a half miles from the dam, and is designated as the "*Austin Farm Tunnel.*" Between this and Mill River, there are several valleys where the depression of the earth varies from 5 to 15 feet below the grade of the aqueduct, and from 20 to 30 feet to the top filling.

At Mill River, 13 miles from the dam, the work is very imposing. The depression of the valley, through which the stream passes, is 72 feet below grade; and the foundation wall, including the aqueduct, reaches to the height of 87 feet above the bed of the river. The culvert through which the water passes is 25 feet in diameter and 172 feet in length.

From Mill River, proceeding south, we pass five depressions of various depths, averaging about 12 feet each, on all of which it has been necessary to erect culverts, of dimensions suitable to the exigence of each case. Two miles be-

low Mill River, another tunnel, which we have designated as the "*White Plains Tunnel*," from its laying near the road leading from Tarry Town to the Village of White Plains. The tunnel is 246 feet in length, mostly through rock. This tunnel is in the vicinity of Requa's Brook, where the depression is about 15 feet below grade, and the wall and embankment 25 feet to the top of the back filling

The next important work is at Jewell's Brook and Ravine, 17½ miles from the dam. The depression of this hollow is so great, as to require a foundation wall of 50 feet to grade, and 62 feet to the top of the embankment. The culvert for the passage of the stream is 6 feet diameter and 148 feet in length. The embankment of the aqueduct at this place destroyed a farm road, and the elevation being too great to permit a passage over the aqueduct, it became necessary to substitute a road-culvert, at a very heavy expense. It is 14 feet in width and 141 feet in length, and is a specimen of excellent workmanship. The labor performed, in carrying the aqueduct over this deep ravine, has been immense; and in our view, the whole structure is one of the most arduous undertakings on the line, and is finished in a manner that does great credit to the contractors.

We pass now from Jewell's to Wiltsey's Brook, 18½ miles from the dam, where the depression is 36 feet below grade, and 49 to the top filling of the aqueduct. The culvert is 6 feet in diameter, and 137 feet in length. At the distance of about half a mile south, we meet a tunnel in the vicinity of Dobb's Ferry, which we have designated as the "*Dobb's Ferry Tunnel.*" It is excavated entirely through earth, 262 feet in length. In crossing Storms' Brook, we found the depression 29 feet, and the rise to the top of the aqueduct 40 feet. The culvert is 6 feet diameter and 137 feet in length.

From this, the aqueduct passes several small valleys, of 10 to 15 feet in depth, and arrives at Cook's Run, where the foundation wall is raised about 30 feet above the stream, and

42 feet to the top of embankment. The culvert for discharging the water, is 4 by 132 feet. This brings us to the termination of the second division.

At Dyckman's Brook, on the third division, and about 22 miles from the dam, the valley is depressed 21 feet, and the foundation wall is 21 feet in height to grade, and 35 feet to the top of embankment.

We now arrive, after passing four or five small valleys and creeks, at the Village of Yonkers, where there is a very formidable work executed at tunnelling. The excavation is through earth and rock 684 feet in length, carrying the aqueduct into the valley of the Saw Mill River, and we have accordingly designated it as the "*Saw Mill River Tunnel.*" This valley is about 25 miles from the Croton dam on the line of the aqueduct, and the foundation wall in crossing it, has to be raised 42 feet, to bring it to grade, and to the top covering of the aqueduct, 56 feet. The culverts are double, and of the largest dimensions, being each 25 feet in diameter, and 90 feet in length. Another of those expensive structures had to be erected at this place, for passing the aqueduct over the highway. It has a span of arch of 20 feet, and is 31½ in length, with the proportional height of abutments.

After passing a small stream of water, called Nodine's Run, we encounter another considerable elevation of land, through which it became necessary to drive a tunnel in the solid rock, of 810 feet in length. This tunnel carries the aqueduct into the Valley of Tibbit's Brook, and it has accordingly been designated as the "*Tibbit's Brook Tunnel.*" At the crossing of this brook, 26 miles from the dam, we found the depression of the valley 27 feet below grade, and 40 feet to the top filling of the aqueduct. The culvert for passing the water is 6 feet in diameter, and 107 feet in length.

Leaving Tibbit's Brook, we pass several runs of water in this division, on which small culverts have been built, but

have not deemed it necessary to notice them particularly, as but one of them, called O'Brien's Run, is more than 5 feet below grade. The aqueduct here leaves the third division, and enters the fourth.

On the fourth division there are five streams, all in the County of Westchester, with culverts to each, of small dimensions, which are crossed by the aqueduct, on its way to the Harlaem River. The largest of these streams is at Acker's Brook, where the depression is 28 feet below grade, and 37 to the top of the aqueduct.

Arriving at the crossing place on the Harlaem River, 33 miles from the Croton dam, we proceed with a brief description of the bridge which the Commissioners are directed to build, in accordance with the Act of the Legislature, passed for that purpose, on the 3d of May, 1839. The width of the river, at this station, is 620 feet; and the length of the bridge, from the pipe chamber, on the Westchester side, to the pipe chamber, on the New York side, is about 1,420 feet. It is 18 feet in width, inside of the parapet walls, and 27 feet from the outer edge of the coping. There will be 16 piers as supporters to the bridge; 6 in the river and 10 on the land. Of those on the land, 8 are on the Westchester side of the river, and 2 on the New York side. The piers in the river are to be 20 by 40 feet at base, and about 84 feet in height to the spring of the arch, diminishing in their dimensions as they rise in height. The arches will have a span of 80 feet. The piers on the land will be proportionably less in size, their height varying in accordance with the ascending ground, and the span of these arches will be reduced to 50 feet each.

The central height of the arches in the river is to be 100 feet above high water level in the clear; and the distance from high tide to the top of the parapet walls, will be 116 feet. The total elevation of the bridge, from its base, at the bottom of the river, to the top of the parapets, will be about

138 feet. The piers are to be built of large stone, well hammered, and laid in courses of uniform thickness, and dressed to a joint of a quarter of an inch.

The piers and abutments will be carried up with pilasters to the top of the parapets, with a projection of 2 feet beyond the face of the work. Those piers to be built in the river will commence on the solid rock, which will be found at various depths, believed to be from 20 to 30 feet below ordinary tide.

The bridge is intended for the support of iron pipes; and there will be laid down, in the first instance, 2 of three feet diameter, which it is presumed will supply the city with a sufficient quantity of water for many years to come. The work, however, will be so arranged, that at any time hereafter, there may be laid down 2 four-feet pipes, calculated to supply a quantity equal to the capacity of the aqueduct. The pipes will be secured from the effects of frost, by a covering of earth 4 feet in depth, well sodded on the top.

The aqueduct enters the pipe chamber on the Westchester side of the river, and the water is then carried over the bridge, through the iron pipes, to the pipe chamber on the New York side, when the aqueduct again commences its route towards the city.

The first obstacle met with, on leaving the Harlaem River, and entering the Island of New York, is a ravine to be passed, of thirty feet to the top line of the embankment. And at a short distance further, a tunnel has to be worked through the hill, of 234 feet in length. It is located about 33½ miles from the dam, on the land of the late Stephen Jumel, and we have accordingly designated it as the "*Jumel Tunnel.*"

Another ravine occurs at a short distance south of the tunnel, of 25 feet below the grade line of the Aqueduct; and on section 88 there is a very deep ravine, requiring a foundation of 30 feet in height, to bring it to grade.

Nothing of any importance occurs, after passing the afore-

said ravine, until the aqueduct arrives at Manhattanville. On the north side of the valley, before descending the hill, we meet the longest tunnel on the whole line of aqueduct. It is located on sections 90 and 91, part on each, and is 1,215 feet in length. This tunnel will be known as the "*Manhattan Hill Tunnel*," and is just 35 miles from the Croton Dam on the line of the aqueduct.

The water will be carried over the Manhattan Valley by the means of iron pipes, or inverted syphons. The depression of the valley is 105 feet below the grade line, and the same arrangement of pipe chambers, on both sides of the valley, will be required, as that alluded to in crossing the Harlaem River. The pipes are to be laid on a foundation of stone, covered with a course of concrete masonry, 6 inches thick. After the pipes are laid, concrete is to be worked under them, as a support, 18 inches wide and 12 inches high. The whole to be covered with a sufficient depth of earth, as a protection from the effects of frost, and other injury. The aqueduct having terminated at the pipe chamber on the Manhattan Hill, it again commences at the pipe chamber on the Asylum Hill; and after proceeding a short distance south, another, and the last of the tunnels, occurs, of 640 feet in length, which we have designated as the "*Asylum Hill Tunnel.*" It is located near the Bloomingdale Asylum, 36 miles from the Croton Dam, and partly on Sections 92 and 93 of the aqueduct.

We now pass to Section 94, where a very important and expensive work occurs in crossing the valley of the estate of John Clendining, deceased, 37 miles from the Croton. Here the aqueduct has to pass over six streets, from One hundred and first to Ninety-sixth street, inclusive. The depression of the valley is from 33 to 48 feet below grade, and a bridge is in the progress of building, of a corresponding height. The line of aqueduct runs 100 feet east of the Ninth avenue; and on the land, extending from one street to the other, a foundation wall is to be built, of sufficient width

and height to support the aqueduct. Over the carriage way and sidewalks of each street there will be circular arches turned. Ninety-sixth street, being 100 feet in width, will have two arches, of 27 feet span, for the carriage way; and an arch, of 14 feet span, on each side, for the side walks. The other streets, being only 60 feet in width, will each have an arch of 30 feet span for the carriage way, and an arch on each side, of 10 feet span, for the sidewalks. The breadth over the arches to be 24 feet. All the work to be of the same description of solidity and architecture as that for crossing the Harlaem River.

On the whole line of aqueduct there are to be ventillators, placed at one mile distant from each other; and between each ventillator three square openings are left, covered with a flag stone, and their location designated by a monument; in order, if more vents be required, they may be constructed over these openings. There are *twenty-four* of these ventilators now completed, rising up like pyramids, and may be plainly distinguished at a distance, marking the line of aqueduct throughout its whole route. Some of them are intended for the double purpose of vents and waste weirs, and for the means of entering the aqueduct, should repairs, or other cause, require it.

The next important work is the receiving reservoir, 38 miles from the Croton Dam. It needs no detail of description, further than to state, that it covers between 30 and 40 acres of land, and is divided into two Sections, the north to contain about 20 acres, and the south 15, or the residue of the land, more or less. The north Section to have 20 feet of water when full, and the south 25 feet. The whole reservoir will hold about one hundred and sixty millions of gallons.

From the receiving reservoir the water will be conveyed through the Fifth avenue, to the distributing reservoir at Murray Hill, or Forty-second street, by means of pipes 30

inches in diameter. This reservoir covers about 5 acres of land, and is estimated to hold twenty millions of gallons.

We have now arrived, in our brief description, at the termination of the work, so far at least as the supervision of the Commissioners is concerned. That part of it which relates to the distribution of the water through the streets of the city, is the proper province of the Corporation, and will be performed under their special supervision.

By the foregoing sketch, some of the natural obstacles to our progress in the work are referred to: they principally arise from the very uneven surface of the land through which the aqueduct had to pass. The numerous ravines, hollows, and valleys, some of them 40, some 50, and some 80 feet in depth, which had to be crossed on the regular grade of an inclined plane of near 14 inches to the mile, amounting in the aggregate to more than a thousand feet in depth, was not to be effected but by a large amount of physical labor and exertion. When we add to this, the difficulties encountered in penetrating the high hills, compelling a resort to the laborious and tedious operation of tunnelling, most of it through the solid rock, and measuring in the aggregate about 7,000 feet, or one mile and a third in length, and also the great amount of excavation performed in many places, 25 and 30 feet in depth, through earth and rock, we that have been familiar with the progress of the work, are lost in astonishment that the physical strength of man, by whose personal prowess the greater part of the work, we have attempted to describe, was performed, has been equal to the task.

Referring only to the most prominent portions, such as the dam at Croton; the crossing at Sing Sing Kill; the large culvert and high embankment at Indian Brook, Saw Mill River, Tibbitt's brook, and Jewell's Ravine; the bridge crossing Harlaem River; the syphons at Manhattanville, and the receiving and distributing reservoirs; and to which may be

added, the crossing at Clendining Valley, and we have, at one view, a more stupendous and imposing grouping than can be referred to in this or any other country, where similar works have been attempted.

All which is respectfully submitted.

STEPHEN ALLEN,
WILLIAM W. FOX,
THOMAS T. WOODRUFF,
CHARLES DUSENBERRY,
SAUL ALLEY,
} *Water Commissioners.*

OFFICE OF THE WATER COMMISSIONERS,
January 2, 1840.

REPORT

OF THE

CHIEF ENGINEER,

ON THE

PROGRESS OF THE WORK ON THE

CROTON AQUEDUCT.

NEW YORK, 24TH DECEMBER, 1839.

To the Honorable the Board of Water Commissioners of the City of New York:

GENTLEMEN—The following statement shows the progress of the work on the Croton Aqueduct up to this time, to which some remarks are added in relation to the present condition, and prospect of the time that will be required to complete what remains to be done:

AQUEDUCT.

54 Sections of aqueduct completed and accepted—aggregate length	20.973 miles
On the remaining Sections which are unfinished, the masonry of the aqueduct has been constructed for the aggregate length of	5.377 miles
Total length of aqueduct masonry, completed	26.350 miles

The *length* of the line of *aqueduct*, from the *Croton Dam* to *Harlaem Bridge*, is .. 32.880 miles
The length, from North end of Harlaem Bridge to south side of the distributing reservoir is 7.687 miles

Total length of aqueduct line ..... 40.567 miles

UNFINISHED WORK.

There is unfinished masonry for aqueduct in Westchester County		6.698 miles
Harlaem River Bridge	0.275	
For masonry aqueduct, between Harlaem Bridge and Manhattan Valley	2.015	
Iron pipes across Manhattan Valley ..	0.792	
Masonry for aqueduct between Manhattan Valley and the receiving reservoir	2.004	
Iron pipe to connect receiving and distributing reservoirs, including length across reservoirs	2.433	
		7.519 miles
Total length of unfinished masonry and pipe		14.217 miles

Of the above unfinished line there is in length as follows:

Aqueduct of masonry	10.910	
" " iron pipe, including Harlaem Bridge	3.307	
		14.217 miles

CULVERTS COMPLETED.

7 of	1	foot diameter, aggregate length		224 feet
58 "	1½	feet " " "		3,179 "
65	Amounts carried over			3,403 feet

65	Amounts brought over					3,403	feet
7	of	2	feet	diameter,	aggregate length	401	feet
9	"	3	"	"	"	601	"
14	"	4	"	"	"	1,166	"
10	"	6	"	"	"	1,038	"
2	"	8	"	"	"	222	"
1	"	10	"	"	"	80	"
1	"	14	"	"	"	141	"
2	"	16	"	"	"	110	"
1	"	20	"	"	"	30	"
2	"	25	"	"	"	350	"
114					Total length	7,542	feet

One of the 25 feet culverts has two arches,

CULVERTS IN PROGRESS.

1 of 3 feet diameter. Length 52 feet

VENTILATORS.

23 completed.
2 in progress.

WASTE WEIRS.

1 completed.
2 in progress.

TUNNELS COMPLETED.

	Length.	Length perforated	Length of masonry
Completed in rock 1 of	166	166	166
" " " 1 of	276	276	276
Amounts carried forward	442	442	442

		Length.	Length perforated.	Length of masonry.
Amounts brought forward		442	442	442
Completed in rock	1 of	334	334	334
" " earth	1 of	160	160	160
" mostly rock	1 of	708	708	708
" " rock	1 of	168	168	168
" " earth	1 of	256	256	256
		2,068	2,068	2,068
In progress in rock	1 of		200	
" " " earth and rock	1 of		336	331
" " " rock	1 of		205	
" " " earth	1 of		89	77
" " " earth and rock	1 of		603	
" " " rock	1 of		510	
" " " "	1 of		100	
" " " "	1 of		80	
" " " "	1 of		10	
			4,201	2,476

Aggregate length of tunnel perforated 4,201 feet
" " " " completed 2,476 "

SUMMARY

Of Cubic Yards of the principal items of Work.

Excavation of earth	1,388,223	
" " rock	283,756	
Total earth and rock excavation ———		1,671,979 c. yds
Embankment	294,234	
Back filling	944,317	
Total embankment & back filling ———		1,238,551 c. yds

Foundation wall	115,210	
Protection wall	114,384	
Total dry wall	———	229,594 c. yds
Hydraulic masonry in aqueduct	243,317	
" " " culverts, &c.	30,507	
Total hydraulic masonry ..	———	273,824 c. yds

There were at work on the aqueduct,

On the 25th of	July,	1839,	3,328	men and	teams
" " 24th "	August,	1839,	3,233	" "	"
" " 25th "	September,	1839,	2,992	" "	"
" " 24th "	October,	1839,	2,243	" "	"
" " 20th "	December,	1839,	1,413	" "	"

The work is now progressing at the Croton reservoir, Croton dam, State farm tunnel No. 2, Mill River, White Plains road tunnel, Saw Mill River tunnel, Saw Mill River walls, Tibbit's Brook tunnel, Harlaem River foundations, Jumel tunnel, Manhattan Hill tunnel, Clendining Bridge, receiving reservoir and distributing reservoir. There is at several other places more or less work progressing in excavation, dry walls, and procuring materials.

It is probable the work will continue through the winter to employ about 1200 men and teams.

As the work has permitted, the Engineer department has gradually been reduced, and is now composed for the several divisions, as follows:

1st Division,	1 Resident Engineer.
" "	2 Assistant Engineers.
" "	1 Inspector.
" "	1 Axeman for part of the time.
Carried over	5

Brought over,	5	
2d Division,	1	Resident Engineer.
" "	2	Assistant Engineers.
" "	1	Inspector.
" "	1	Axeman for part of the time.
3d Division,	1	Resident Engineer.
" "	2	Assistant Engineers.
" "	1	Axeman.
" "	1	Inspector for part of the time.
4th Division,	1	Resident Engineer.
" "	3	Assistant Engineers.
" "	3	Rodmen.
" "	1	Inspector.
" "	2	Axemen.
Total	25	
In this office,	1	Draftsman.
	26	

For the 1st, 2d, and 3d divisions, it is expected the above arrangement will be required for the winter. For the 4th division, it is contemplated to dispense in a short time with one or two Rodmen and one Axeman. The Draftsman will probably be needed until March next.

The only work that has not been put under contract, is the grading of the Fifth avenue, which will be necessary before laying the iron pipes to connect the receiving and distributing reservoirs. This will be prepared for contract early next spring.

On the presumption the work will be prosecuted with the same energy as heretofore, that part which remains to be done in Westchester County will be completed next season,

with the exception of three or four Sections, which will be well advanced. It may therefore be expected, that early in the season of 1841, the entire line of aqueduct, from the Croton reservoir to Harlaem River will be ready to receive the water. The work on the island, includes several heavy and important structures, which will require more time for completion, than the work in Westchester County. The principal of these are, Clendining Bridge, receiving reservoir and distributing reservoir. There are other works of considerable magnitude on the island, but they may be easily completed by the time required for those above mentioned. Up to the present time, the progress on Clendining Bridge and the two reservoirs, has mostly been in preparing foundations and the incipient arrangements required for their prosecution. They are now advanced to a condition that will admit a very energetic prosecution the ensuing season. It is the opinion of the undersigned, they may all be completed early in the Spring of 1842. To accomplish this, in a way that will do justice to these important structures, will require a well directed energy in their prosecution, which it is fully believed may be successfully applied.

The contractors for Harlaem Bridge have not made as much progress as was expected for the time that has elapsed since they entered into contract for the work. Three of the partners have been much occupied in finishing Sections for which they had previously contracted; which has doubtless operated to prevent that energetic and uniform course of proceeding, necessary in conducting such a work. They are now very considerably relieved from their previous contracts, and give strong assurances that no effort on their part shall be wanting, to carry forward the work with a progress commensurate with its importance.

The following estimate has been prepared to show the probable amount of funds that will be required for the contracts and the Engineer department the ensuing year:

On the	25th of February,	$ 70,000
"	25th of April,	100,000
"	25th of May,	150,000
"	25th of June,	225,000
"	25th of July,	225,000
"	25th of August,	250,000
"	25th of September,	250,000
"	25th of October,	250,000
"	25th of December,	200,000
	Total amount,*	$1,720,000

It is obvious the above estimate can only be regarded as an approximation, but it is believed it will be found sufficiently near for the purpose of guiding financial operations.

The Croton dam is expected to be completed next season. The great height of this dam will render the operation of closing the natural channel of the river, a work of considerable difficulty, particularly if the season should be marked by frequent floods, careful attention will be required to conduct the operation, so as to secure the work from injury, that might otherwise be experienced by a sudden rise in the river. It is believed every necessary provision is in progress to secure a successful result.

From the preceding statements, it will be seen that the whole line of work, excepting the Harlaem Bridge, may be completed and ready for use in the Spring of 1842. The completion of the bridge, cannot be expected before the close of 1843; and it is believed there is more probability that its completion will be delayed beyond that period, than that the remainder of the work will require longer time than above mentioned. As it will probably be deemed expedient, to lay down a temporary pipe to carry the water across Harlaem valley, as proposed in my report on the plans for crossing the river, made to the Board in June last, the delay in com-

pleting the bridge need not retard the introduction of the water into the city, beyond the time necessary for completing the remainder of the work, early in the season of 1842.

The es imate for the cost of the work, made by the undersigned, December, 1837, including contingent allowance and superintendence for the whole work, exclusive of land, amounted to $7,877,466

To which must be added the excess of estimate for Harlaem River Bridge, made June last, over the one for the low bridge, included in the above estimate of 1837 443,432

Total estimated cost †..... $8,320,898

It may be considered, that the progress of the work has indicated the most essential contingencies that may affect the cost of what remains to be done, of all except that at Harlaem River, and a close approximation to the final expense of the work, may now be determined. Believing it will be interesting at this stage of our progress, to know whether the estimates will be adequate to meet the final cost, a revision of the estimate of unfinished work has been made. The result of this examination has been very satisfactory—giving strong confidence in the opinion, that the final cost of the work will not vary 5 per cent. from the estimate, and more probable that it will fall below than exceed it.

Respectfully submitted.

JOHN B. JERVIS,
Chief Engineer N. Y. Water Works.

* Note No. 1, by the Commissioners. To the estimate of the probable sum required for the ensuing year of $1,720,000
There should be added the amount of the two unliquidated requisitions 341,249
Also, for contingencies, say 10,000

$2,071,249

† Note No. 2. To the estimated cost of the whole work, amounting to $8,320,898
There must be added, the cost of land, Chancery and law expenses, printing, stationery, and contingencies 586,567

$8,907,465